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Response of fiscal efforts to oil price dynamics

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ABSTRACT

This study investigates the response of Nigeria's government balance to oil price dynamics. The Linear and Non-Linear Autoregressive Distributed Lag models are employed for analysis. The findings of the study reveal that while the long run response of government balance to oil price dynamics is symmetric, the short run response is asymmetric. In the long run, an increase in oil price improves the government's fiscal position, signifying an increase in fiscal effort. Interestingly, while positive oil price shocks lead to a short run worsening of the government's fiscal position, indicating poor fiscal efforts, negative oil price shocks influence an improvement of government fiscal efforts. Further, although the operationalisation of fiscal rules worsens the government's fiscal position in the short run, it has a beneficial long run effect. These findings have far-reaching policy implications.

1. Introduction

The interdependency among economies leads to dynamic policy actions to avert the shocks that may emanate from international commodity markets such as the crude oil market. Economies are highly sensitive to the occurrence in the global oil market, this is not surprising considering that oil remains a key source of energy and a key determinant of government finances for economies that heavily rely on oil revenues for budget planning and execution. According to the IMF (2022), the government's primary balance is a key indicator of the government's fiscal effort and by extension the fiscal position of a country.

Poor resource management, oil price volatility and heavy reliance on external financing explains the persistent budget deficit in oil producing countries (Borozan and Cipcic, 2022). In relation to this, Eregha and Mesagan (2020) have shown that most oil-producing countries engage in fiscal deficits by essentially raising their spending since these countries treat oil price boom as permanent shock. This is supported by Eregha et al. (2022) who indicate that increased vulnerability to changes in oil price can result in fiscal deficit for most African oil-producing countries. Consequently, for oil-producing countries like Nigeria, the price of crude oil has a great influence on the country's fiscal position.

Since the discovery of oil in commercial quantity in the 1950s, the Nigerian economy has been largely oil-focused, with little attention paid to the development of other sectors and diversification of the economy (Akinboyo, 2020). This makes oil the major source of the foreign exchange earnings of the country but also exposes the economy to the risk of fluctuation in global oil prices. The Nigerian government heavily relies on oil revenue to finance its expenditure; the annual budget is planned based on a benchmarked crude oil price and quantities to be supplied to the market based on the daily quota from OPEC (Omojolaibi and Egwaikhide, 2014). Consequently, shocks in the oil market, especially oil price has far-reaching implications for fiscal operations and macroeconomic policy in Nigeria (Akpan, 2009; Babalola, Akindele, and Rotimi, 2018).

Data on average crude oil price[1] per barrel (see Fig. 1) indicates that oil price per barrel increased from about $26 in 2002 to about $56 in 2005, and sharply to about $100 in 2008. Average crude oil prices experienced a sharp drop to about $60 in 2010 before rebounding to over $90 from 2012 through 2014. However, a sharp decline in the price

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of crude oil was experienced in 2015 through 2016 before rebounding a little in 2017 and thereafter dipping again until the end of the study period i.e., 2020. Interestingly, since the beginning of the new millennium onwards, the government primary balance in Nigeria exhibited a similar trend to changes in crude oil price, this is evident in Fig. 1 where periods of decline in oil price also exhibit dips in government primary balance and periods of oil price appreciation are associated with a rise in government primary balance. The co-movement between the variables is an indication of a close relationship between them. A close relationship between oil price and government balance in the case of Nigeria is not surprising considering that Nigeria is an oil-based economy, with oil revenue contributing greatly to government revenue. What is not clear however is if the relationship between the variables is symmetric or asymmetric.

Nigeria's major fiscal challenge has been its inability to finance its budget without resorting to budget deficits that are financed largely by borrowing either internally or externally, this is despite the huge revenues received from oil, especially during periods of a significant rise in oil price. Further, Nigeria's tax-to-GDP ratio averages around 6% against the continent's average of about 16% (OECD, 2021); therefore, tax revenues are inadequate hence the dependence on oil revenue.

Oscillation in oil price and its impact on fiscal policy has been modelled severally on the assumption that the relationship is symmetric (see Anshasy and Bradley 2012; Nusair and Olson, 2021; Asandului et al., 2021). However, recent development revealed that macroeconomic variables exhibit nonlinearity and asymmetric relations (Shiller 1993; 2005). Fluctuations in oil price could have a contractionary and expansionary impact on the fiscal position of a country, with the conventional belief being that increase (decrease) in oil price improves (worsens) the fiscal position of oil exporting countries, this might not always be the.

case. It could be that the fiscal position of an oil-exporting country like Nigeria responds differently to changes in oil price. Periods of oil price appreciation could be associated with greater government spending when such government gets too excited and loosen its fiscal stance thereby worsening the fiscal position of the country. Conversely, periods of oil price crunch could influence the adjustment of fiscal policy with the aim of avoiding holes in the budget, this could culminate in actions that would improve government balance. In addition, the magnitude of the response of government balance to oil price increase could differ from that of oil price decrease. These behaviours are best modelled using dynamic asymmetric models such as the Non-Linear ARDL model developed by Shin et al. (2014). The model provides a simple framework through which short run and long run asymmetric relationships between oil price and government balance can be estimated.

Although there is a growing literature on the effect of oil price on macroeconomic variables (Okunoye and Hammed, 2020; Olusegun, 2008; Ologbenla, 2019), the response of government fiscal effort given by the primary balance to oil price dynamics has received less attention despite the fiscal implication of changes in oil prices on oil-based economies such as Nigeria. To the best of our knowledge, no empirical study focusing on Nigeria examined the asymmetric response of government balance to oil price dynamics. Consequently, this study contributes to the oil price-fiscal policy literature by examining the asymmetric effect of oil price dynamics on Nigeria's fiscal effort. In addition, to the best of our knowledge, no empirical study in the context of Nigeria examined the effect of the operationalisation of fiscal rules on the government's fiscal position; this study contributes to the literature in this regard.

The rest of the paper is organised as follows: section two focuses on the theoretical and empirical literature review, while section three details the methods, model, and data issues. Section four presents the estimation results and discusses the findings, while section five concludes the study.

2. Literature review

2.1. Theoretical review

In examining the relationship between oil price and fiscal policy outcomes, the Exhaustible Resource Theory comes in handy. The theory was propounded by Hartwick (1977) and is originally known as the "Hartwick rule". The main assertion of the theory is that all the proceeds/rents from non-renewable resources such as crude oil should be invested in the reproductive capital of the country (Dixit et al., 1980; Dasgupta and Mitra, 2002; Asheim, 2013). Since government capital investment forms part of its fiscal operations, the fiscal balance arising from the government's budgetary needs is affected by oil proceeds. The proceeds from oil are in turn affected by the price of oil in the international market.

Most oil-dependent countries base their budgets on oil sales revenue. As a result, government fiscal policy is strongly linked to the price of oil. This indicates that oil price affects oil proceeds, consequently influencing the balance of the government. The proceeds from oil (which largely depends on oil price) can lead to either a deficit or surplus government balance. A rise in oil price generates additional revenue for the oil-exporting country which can be used to finance both investment and non-investment government expenditures and generate excess revenues which translate to higher government surpluses. However, it could result in government deficits which come about as a result of lower revenues occasioned by an oil price-induced decline in economic activities. Conversely, a fall in the price of crude oil could exert a negative effect on the balance of oil-exporting countries due to a fall in

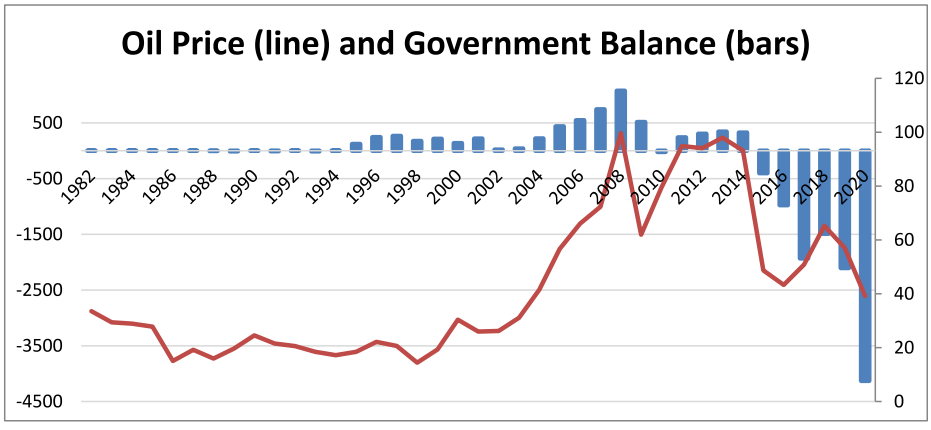

Fig. 1. Average crude oil price and government balance in Nigeria.
Source: Authors' computation using data from EIA and Central Bank of Nigeria.

government revenues. In the absence of fiscal buffers and adjustment measures, this could pose a difficult fiscal challenge to oil-dependent countries. To counteract this, Kilian (2010) asserted that there are compelling reasons for oil exporters to reinvest some of their oil revenues in the global financial system. This will serve as an opportunity for oil producers to smooth expenditures in expectation of a future downturn in the oil price.

2.2. Empirical review

The empirical literature on the relationship between oil price and fiscal indicators is without consensus; while some studies find the effect of a rise in oil price on fiscal balance to be positive, others find the relationship to be negative. However, the studies that examined the asymmetric response of government balance to oil price dynamics are limited. Among the studies that examined the response of government fiscal stance to oil price dynamics is Sohag et al. (2022). The study employed the Dynamic Simulated ARDL model to investigate the response of Russia's fiscal stance to oil and gas prices by utilising monthly series covering the period 2011 to 2021. The findings of the study illustrated a positive response of government fiscal stance to a positive oil price shock. Conversely, the response of the government's fiscal stance to a negative oil price shock is negative. Similarly, El Mahmah and Kandil (2019a) found that oil price fluctuations have an impact on the UAE's fiscal balance; higher oil prices result in a budget surplus, whereas lower oil prices cut government revenue more rapidly than government spending, resulting in a budget deficit. In a related study, El Mahmah and Kandil (2019b) provided evidence to show that oil price is a significant factor in explaining fiscal performance. Using the GMM approach to analyse data for a group of six GCC countries covering 1990 to 2016, the findings of the study reveal that a rise in oil price raises government revenue and, as a result, primary surpluses in oil-exporting countries. It was further revealed that an increase in oil price raises government expenditure on imports and subsidies in emerging oil-importing countries which reduces the primary fiscal balance.

Conversely, the studies that found a negative effect of oil price on fiscal balance include Bash (2015) who employed the Vector Auto-Regressive (VAR) model to evaluate the impact of oil price fluctuations on the Jordanian public budget. The result of the study revealed that crude oil price significantly influences the budget deficit in Jordanian largely due to its dependence on imported crude oil and petroleum products. The study found that a rise in crude oil prices results in a rise in the public budget deficit in Jordan. Specifically for oil-exporting countries, Shaheen (2021) found an increase in fiscal deficit in a regime of higher oil prices for all countries except Canada; the study employed the Structural Threshold Vector Autoregression model for the analysis of data covering from 1991 to 2019.

Further, Fatai et al. (2017) examined the relationship between crude oil rents and fiscal balance while controlling for other explanatory variables for a panel of oil-dependent economies from 2000 to 2015. Using the Generalised Method of Moment (GMM) for analysis, the study found that fiscal balance reacts insignificantly to changes in oil rent shocks, with the impact being minimal in countries with fiscal rules. In addition, the findings obtained by Alley (2016) show that oil-exporting countries' fiscal policies are not procyclical, but rather driven by oil price volatility. The study revealed that in the short run, primary fiscal balance decreases in response to oil price volatility. Similarly, Faheem et al. (2021) pointed to the crucial adverse implication of oil price volatility on Saudi Arabia's fiscal position and economy.

The studies that investigated the relationship between oil price and the components of fiscal balance include Ibrahim et al. (2019) which examined Oman's fiscal balances and its susceptibility to oil price shocks in the short and long run. By utilising annual data from 1980 to 2016 and the Vector Autoregressive model for analysis, the result of the study revealed a slower growth in government revenue for most of the quarters owing to falling oil prices. In some cases where there is a rise in government revenue, such an increase quickly dampens, demonstrating a high vulnerability of government revenue to oil price shocks in Oman. Concerning government expenditure, the study found an overall growth in expenditure from 2007 to 2016, however, this growth slowed from 2013 to 2016. The findings also showed that falling oil price curtails government spending. Similarly, Sadeghi (2017) investigated the response of government expenditure and national output to oil price shocks in a panel of 28 oil-exporting nations between 1990 and 2016. The study found that an increase in oil prices leads to an increase in government spending. The study also discovered that in oil-exporting countries, there is a direct link between government spending and macroeconomic stability. Faheem et al. (2021) found that a rise in oil price increases government expenditures in both the long run and short run. Also, there is evidence of an asymmetric response of expenditure to changes in oil price. Further, Raouf (2021) found that revenue gained from rising oil prices facilitates increasing the current and capital spending of oil-exporting countries. Focusing on oil-exporting countries. Also, El Anshasy and Bradley (2012) examine the role of oil prices in determining fiscal policy. The study found that higher oil prices, in the long run, lead to larger government size. However, in the short run, government expenditures soar less than correspondingly to rises in oil revenues, implying fiscal discipline in oil-producing countries.

Subsequently, some studies with a specific emphasis on asymmetries have also provided a series of conflicting findings. In Nigeria, Adeosun and Fagbemi (2019) examine the asymmetric linkage between commodity prices and fiscal performance between 1984 and 2017. The authors argue that it may not be reliable to assume a symmetric link between fiscal performance indicators and commodity prices. Employing the NARDL and accounting for asymmetry, they revealed that fiscal indicators (debt % of GDP and external debt stocks) significantly rise when oil prices fall. However, the fall in external debt stocks is higher in the presence of a decrease in oil prices. The authors further provided evidence of the asymmetric impact of commodity prices. This study differs significantly in the measurement of fiscal performance. In another study, Zulfigarov and Neuenkirch (2020) provided evidence of the asymmetric effect of oil price changes on some selected macroeconomic indicators. With the use of the Vector autoregression (VAR), the result of their study evidenced that growth effects are typically observed after (net) increases in oil prices. According to the authors, monetary policy is a key factor in determining why negative oil price shocks have such a minimal recessionary impact on Azerbaijani economic growth. Their findings suggest that monetary policy can be utilized to lessen the impact of oil price shocks on macroeconomic indicators. In a recent study, Okoro (2021) sought to unravel whether asymmetric fluctuations in oil price have a similar or different impact on oil-importing and oil-exporting African countries. The findings reveal the asymmetric effect of macroeconomic indicators in response to oil price changes in both net oil exporting countries and net oil exporting countries using the Panel ARDL approach. In a cross-country study focusing on oil-exporting and oil-importing countries, Hashmi, Chang, and Bhutto (2021) employed both the QARDL and QNARDL to establish an asymmetric effect of oil price changes in the long-run and short-run for both oil-exporting and oil-importing countries. The authors found no evidence of asymmetric influence in the short run using the NARDL for all the countries sampled. In a more recent study in Croatia, Borozan and Cipcic (2022) using an oil-importing small open economy sought to unravel if the oil price pass-through to economic growth is asymmetric and nonlinear. The authors provided evidence in support of studies that conclude that oil price shocks have an asymmetric, nonlinear, and direct impact on real GDP growth. Several other studies including Su et al. (2021) and Nusair and Olson (2021) have documented the asymmetric effect of oil price changes on macroeconomic variables.

However, a strand of studies on asymmetries such as Kilian and Vigfusson (2017) found no evidence of an asymmetric effect of oil price changes on economic activity focusing on 13 Asian economies using the

NARDL model. Particularly in the case of Nigeria, Aregbeyen and Fasanya (2017) examined the relationship between oil price volatility and fiscal behaviour from 1970 to 2013 and found that government spending dynamics in Nigeria are influenced by oil prices. Further, a positive long-run relationship between oil price and government spending was found. Their findings supported no asymmetric effect of oil price shocks on government spending in Nigeria. Similarly, in a related study, Hu et al. (2018) assess the asymmetric effects of structural oil price shocks in China. Utilising the SVAR model and nonlinear ARDL (NARDL) model, the authors found no evidence of the asymmetric impact of structural oil price shocks in China. Also, using the VAR model, Huang et al. (2017)'s result corroborated the findings that oil price changes have no asymmetric influence on stock market return. Focusing on selected 13 Asian economies, Khan et al. (2019) makes a case for the insignificant asymmetric effect of oil price changes on macroeconomic variables using the nonlinear autoregressive distributed lag approach.

From the empirical review, studies on the asymmetric effect of oil price on government balance are limited; most studies focus either on a symmetric relationship between the variables or the effect of oil price dynamics on other macroeconomic variables. Specifically, the asymmetric effect of oil price on government balance in both the short run and long run in the case of Nigeria has not been explored despite being the largest oil-producing country in the African continent. This demonstrates the underrepresentation of discussion on the asymmetric effect of oil price on fiscal position in the literature. Besides, the empirical review confirms the lack of consensus among studies that focused on studying oil price dynamics and macroeconomic indicators. The effect of oil price on fiscal position could be positive, negative, symmetric, or asymmetric which is a clarion call for further investigation. This study contributes to the literature in that regard.

3. Materials and method

3.1. Model specification

A theoretical basis for the analysis of the fiscal position of the government is the government debt identity equation. The equation is specified as:

$$D_t = (T_t - G_t) + D_{t-1} + rD_{t-1} \tag{1}$$

Where D_t is the stock of public debt, T_t and G_t denote government revenue and expenditure respectively, and rD_{t-1} denotes interest on the existing stock of public debt.

Equation (1) states that the stock of public debt in any period t is the sum of the primary balance in period t (difference between government revenue and expenditure), the stock of public debt in preceding period t-1, and interest payment on the stock of public debt in the preceding period t-1.

By re-arranging, equation (1) becomes:

$$(T_t - G_t) = D_t - D_{t-1} - rD_{t-1} \tag{2}$$

This follows:

$$(T_t - G_t) = \Delta D_t - rD_{t-1} \tag{3}$$

Depicting the primary balance as $(T_t - G_t) = B_t$, equation (3) can be presented as:

$$B_t = \Delta D_t - rD_{t-1} \tag{4}$$

Equation (4) states that the government's primary balance is the difference between the change in public debt and the interest on the existing stock of public debt.

Considering the relationship presented in equation (4), the dynamics of the economy, data availability, and the works of Aremo et al. (2012), Emmanuel et al. (2018), Omojolaibi and Egwaikhide (2014), Omisakin et al. (2009) and Ologbenla (2019), the empirical model used to examine the response of Nigeria's fiscal effort to oil price dynamics is specified as:

$$GB_t = \delta_0 + \delta_1 OP_t + \delta_2 DE_t + \delta_3 RGDP_t + \delta_4 FR_t + \varepsilon_t \tag{5}$$

Where:

GB denotes Government Primary Balance, *OP* is Oil price, *DE* is Public Debt, *RGDP* is Real GDP, *FR* is Fiscal Rules. δ_0, δ_1, δ_2, δ_3 and δ_4 are parameters to be estimated, and ε_t is the stochastic error term.

Given that the Nigerian economy is highly dependent on oil, changes in the price of crude oil are expected to have a significant effect on the fiscal position of the government via its effect on government revenues and expenditure plans. Similarly, the outstanding stock of public debt is expected to influence the fiscal position of the government. In response to rising public debt, the government might pursue fiscal tightening to avoid a fiscal crisis and create the fiscal space needed to service the growing stock of public debt. The state of the economy, represented by the real GDP, also influences the government's fiscal position. In periods of economic downturn, government revenue, being a component of the government balance, is expected to decline. Similarly, more government expenditure might be required to pump-prime the economy during periods of economic downturn. Conversely, periods of economic boom are associated with higher government revenues and a lesser need for government intervention. Therefore, real GDP is expected to influence the fiscal position of Nigeria. Fiscal rules are legal constraints aimed at governing the fiscal operations of government (Kopits and Symansky, 1998). There are four rules: budget balance rule, debt rule, expenditure rule, and revenue rule. Since the year 2003, Nigeria adopted fiscal rules (Baunsgaard, 2003); specifically, the budget balance rule which limits fiscal deficit to 3% of GDP (Golit, 2021), and the debt rule adopted for the country's public debt management. Therefore, the adoption of fiscal rules is expected to influence the government's fiscal position.

3.2. Estimation technique

As the first step in time-series analysis, the study examines the order of integration of the variables. To achieve this, the Augmented Dickey-Fuller (ADF) test for unit root is employed for analysis.

The Autoregressive Distributed Lag (ARDL) procedure developed by Pesaran et al. (2001) is used to examine the symmetric relationship between oil price and government balance. The ARDL model is comparatively more robust and efficient in small sample data (Mah, 2000). Moreover, it applies regardless of whether the model's variables are purely I (0), purely I(1), or mutually cointegrated. However, the procedure fails in the presence of I (2) series. Using the ARDL approach, an expression of the symmetric cointegrating relationship between the variables is specified as:

$$\begin{aligned}\Delta GB_t = {} & \gamma GB_{t-1} + \delta_1 OP_{t-1} + \delta_2 DE_{t-1} + \delta_3 GDP_{t-1} + \delta_4 FR_{t-1} \\ & + \sum_{i=1}^{\rho} \alpha_1 \Delta GB_{t-i} + \sum_{i=1}^{\rho} \alpha_2 \Delta OP_{t-i} + \sum_{i=1}^{\rho} \alpha_3 \Delta DE_{t-i} \\ & + \sum_{i=1}^{\rho} \alpha_4 \Delta GDP_{t-i} + \sum_{i=1}^{\rho} \alpha_5 \Delta FR_{t-i} + \varepsilon_t\end{aligned} \tag{6}$$

The error correction model that captures the short run dynamics of the model is specified as:

$$\begin{aligned}\Delta GB_t = {} & \sum_{i=1}^{\rho} \alpha_1 \Delta GB_{t-i} + \sum_{i=1}^{\rho} \alpha_2 \Delta OP_{t-i} + \sum_{i=1}^{\rho} \alpha_3 \Delta DE_{t-i} \\ & + \sum_{i=1}^{\rho} \alpha_4 \Delta GDP_{t-i} + \sum_{i=1}^{\rho} \alpha_5 \Delta FR_{t-i} + ECT_{t-1} + \varepsilon_t\end{aligned} \tag{7}$$

Where Δ is the first difference operator, γ and δ are the long-run parameters, while α represents the short-run parameters. ECT_{t-1} in equation (7) is the error correction term that measures the speed of adjustment of the model to long run equilibrium following a shock in the economy. Although the ARDL technique captures the relationship between oil price and government balance, it does so with the explicit assumption that the relationship is linear and symmetrical. These assumptions are not in sync with the main aim of this study which is to

investigate the asymmetric response of Nigeria's fiscal effort to oil price dynamics. To achieve this objective, the study employs the asymmetric extension of the linear ARDL model, which is the Non-linear Autoregressive and Distributed Lag (NARDL) model propounded by Shin et al. (2014). The NARDL model investigates asymmetric effect by using partial sum decompositions of the variables into the partial sum of positive and negative squares, resulting in consistent estimates with nonlinearities. To specify the NARDL model, the change in oil price ΔOP_{t-i} is decomposed into its positive and negative partitions denoted by $\Delta lnOP^{+}$ and $\Delta lnOP^{-}$ respectively. The partitions are further specified as:

$$OP_t^{+} = \sum_{i=1}^{t} \Delta OP_i^{+} = \sum_{i=1}^{t} max(\Delta OP_i, 0) \tag{8}$$

$$OP_t^{-} = \sum_{i=1}^{t} \Delta OP_i^{-} = \sum_{i=1}^{t} min(\Delta OP_i, 0) \tag{9}$$

Following Shin et al. (2014), the asymmetric cointegrating relationship between the variables is specified as:

$$\begin{aligned}\Delta GB_t = {} & \gamma GB_{t-1} + \delta_1{}^{+}OP_{t-1}{}^{+} + \delta_2{}^{-}OP_{t-1}{}^{-} + \delta_3 DE_{t-1} + \delta_4 GDP_{t-1} + \delta_5 FR_{t-1} \\ & + \sum_{i=1}^{\rho} \alpha_1 \Delta GB_{t-i} + \sum_{i=1}^{\rho} \alpha_2{}^{+}\Delta OP_{t-i}{}^{+} + \sum_{i=1}^{\rho} \alpha_3{}^{-}\Delta OP_{t-i}{}^{-} \\ & + \sum_{i=1}^{\rho} \alpha_4 \Delta DE_{t-i} + \sum_{i=1}^{\rho} \alpha_5 \Delta GDP_{t-i} + \sum_{i=1}^{\rho} \alpha_6 \Delta FR_{t-i} + \varepsilon_t\end{aligned} \tag{10}$$

The asymmetric error correction model is specified as:

$$\begin{aligned}\Delta GB_t = {} & \sum_{i=1}^{\rho} \alpha_1 \Delta GB_{t-i} + \sum_{i=1}^{\rho} \alpha_2{}^{+}\Delta OP_{t-i}{}^{+} + \sum_{i=1}^{\rho} \alpha_3{}^{-}\Delta OP_{t-i}{}^{-} \\ & + \sum_{i=1}^{\rho} \alpha_4 \Delta DE_{t-i} + \sum_{i=1}^{\rho} \alpha_5 \Delta GDP_{t-i} + \sum_{i=1}^{\rho} \alpha_6 \Delta FR_{t-i} + ECT_{t-1} + \varepsilon_t\end{aligned} \tag{11}$$

Where Δ is the first difference operator, δ^{+} and δ^{-} represents the associated asymmetric long-run parameters for positive and negative changes in oil price, α^{+} and α^{-} represents the short-run parameters for positive and negative deviations in oil price. ECT_{t-1} in equation (11) denotes the error correction term.

3.3. Data description

In this section, the data utilized for analysis and its sources are discussed (see Table 1).

All variables except government balance and fiscal rules were converted to their logarithmic form before being used for analysis. Further, considering the variation in the measurement of the variables, to ensure uniformity of data, all variables except fiscal rules (a dummy variable) are converted to their standardised form. The standardisation of the data is implemented using Stata. The data on all the variables are collected for the period 1981 to 2020. The choice of this period is informed by data availability especially those from the Central Bank of Nigeria Statistical Database.

Table 2 presents the descriptive statistics obtained from the measures of central tendency and dispersion (mean median, standard deviation, maximum, minimum, skewness, and Jarque-Bera) applied to the raw data on the variables. From the result, the mean government primary balance is about 0.79 percent of GDP. This implies that in the period covered by the study, on average, Nigeria runs a primary surplus indicating that government revenues exceed expenditures. The highest surplus attained in the period is about 6 percent of GDP while the highest deficit attained is about 2.68 percent of GDP. The average oil price is 5874 Nigerian Naira, with the highest oil price of 19,966 Naira and the lowest price of about 21 Naira. Real GDP and Oil price appeared to have the highest variability; this is not surprising considering the magnitude of the data of these variables.

A standard normal skewness read zero, away from this, a variable may be positively or negatively skewed. As observed from Table 2, all other variables exhibit positive skewness, but none is higher than 1, indicating that the data structure of the variables is not highly skewed. The Jarque-Bera statistics show the degree of normality of the data. From the statistics presented in Table 2, all the variables are normally distributed at the conventional 5 percent level of significance.

Table 3 presents the result of the bivariate correlation matrix and Variance Inflation Factor (VIF) of the study variables. From the result, GDP and oil price is found to be strongly positively correlated. This is not surprising considering that the Nigerian economy is oil-based. Further moderate correlation is observed between the pair of public debt and GDP, and public debt and oil price. To determine if the empirical model is free from the multicollinearity problem, the VIF coefficients are computed. The rule of thumb is a VIF coefficient less than 10 signifies that multicollinearity is not an issue in an empirical model (Angahar and Malizu, 2015; Bala et al., 2021). From the result in the last column of Table 3, all the VIF coefficients are less than 10, and interestingly the mean VIF coefficient is 6.17. Consequently, it could be concluded that the empirical model does not suffer from the multicollinearity problem thereby allowing for further econometric analysis.

Table 1
Data description.

Variable	Definition	Source
Government Balance (GB)	Government primary balance in Naira measured as a ratio of GDP. A negative balance signifies deficit while positive values indicate primary surplus. Following IMF (2022), this is used as a proxy for government fiscal effort.	Central Bank of Nigeria Statistical Database.
Oil Price (OP)	Annual average crude oil price measured in Nigerian Naira[a].	Energy Information Administration (EIA).
Debt (DE)	Total stock of public debt in Naira measured as a ratio of GDP.	Central Bank of Nigeria Statistical Database.
Real GDP (GDP)	Gross Domestic Product at constant prices measured in Naira.	Central Bank of Nigeria Statistical Database.
Fiscal Rules (FR)	A dummy variable that takes the value of 1 if fiscal rule is operational in the respective year, otherwise 0.	IMF Fiscal Rules Dataset.

[a] The data collected on oil prices from EIA was converted to Nigeria Naira by multiplying it with the exchange rate of Naira to Dollar obtained from World Bank's World Development Indicators.
Source: Authors' Compilation.

4. Results and discussion

In this section, the results of the estimated models are presented and discussed.

4.1. Stationarity and cointegration test result

To determine the order of integration of the variables i.e., the number of times the variables need to be differentiated to become stationary, the study employed the Augmented Dickey-Fuller Test for Unit Root, the result is presented in Table 4. Also presented in this section is the Johansen cointegration test. The Johansen cointegration test is

Table 2
Summary statistics.

	GB	DE	GDP	OP
Mean	0.793444	33.07333	37692.03	5873.568
Median	0.375165	24.40746	26935.32	3089.565
Maximum	5.995394	79.71329	72094.09	19965.84
Minimum	−2.676702	7.124324	16211.49	21.30308
Std. Dev.	2.001629	22.78719	20072.59	6388.547
Skewness	0.807453	0.706134	0.592071	0.637387
Kurtosis	3.604218	2.129728	1.746603	1.934766
Jarque-Bera	4.831124	4.471801	4.831446	4.484626
Probability	0.089317	0.106896	0.089303	0.106213

Source: Authors' Computation.

Table 3
Correlation matrix and variance inflation factor (VIF).

	GB	DE	GDP	OP	VIF
GB	1.00				
DE	−0.15	1.00			1.84
GDP	−0.36*	−0.61*	1.00		9.26
OP	−0.32*	−0.64*	0.96*	1.00	7.42
			Mean VIF		6.17

Source: Author's computation. * Statistical significance at 5%.

Table 4
Unit root test result[a].

Variables	Level		First Difference		Order of
	Intercept	Intercept & Trend	Intercept	Intercept & Trend	Integration
DE	−1.84	−2.55	−4.01***	−3.94**	I (1)
GDP	−0.62	−1.40	−5.04***	−4.71***	I (1)
OP	−1.59	−1.12	−6.18***	−6.52***	I (1)
GB	−1.72	−1.85	−6.12***	−6.13***	I (1)

***, **, and * signifies significance at 1%, 5%, and 10% respectively.
[a] The fiscal rules variable was not subjected to unit root test because it is a dummy variable.
Source: Authors' Computation.

Table 6
Estimates of fiscal response baseline model.

Variables	Coefficients	Standard Error
Long Run Estimates		
OP	2.605***	0.512
DE	−0.383	0.235
GDP	−3.223***	0.483
C	1.113***	0.287
Short Run Estimates		
GB(-1)	−0.728	0.147
OP	0.203	0.478
OP(-1)	−2.792***	0.671
OP(-2)	−2.030***	0.628
OP(-3)	−1.894***	0.688
DE	−0.279	0.180
GDP	1.868	1.674
GDP(-1)	−4.099***	1.249
GDP(-2)	−2.180	1.422
ECT	−0.728***	0.128
Bound Test (F Statistic)	5.508**	
BP Serial Correlation Stat	0.069	
BPG Heteroskedasticity Stat	1.400	
CUSUM Test	Stable	
CUSUM of Squares Test	Stable	
Selected Model Based on AIC	ARDL (1, 4, 0, 3)	

***, **, and * signifies significance at 1%, 5%, and 10% respectively.
Source: Authors' Computation

applied to determine the long run association among the variables because they are all integrated of order one. The result is presented in Table 5.

Table 4 reports the result of the Augmented Dickey-Fuller test for unit root. The test is carried out to ascertain the stationarity status of the series. The null hypothesis of the test states that the series under review has a unit root i.e., it is non-stationary. The test is conducted firstly by assuming intercept only and secondly, intercept and trend in the equation. From the result, all the variables are not stationary in their raw or level form, but when converted to the first difference, the null hypothesis of unit root is rejected at a 1% level of significance for all the variables. Consequently, it could be concluded that all the series are integrated of order one.

Table 5 presents the result of the Johnsen Cointergration test. Both the Trace and Max Eigen Value statistics are used to determine if the variables have long run association. From the presented result, the null hypothesis of no cointegrating equation is rejected at 5% significance level for both the Trace and Max Eigen value statistics thereby leading to the conclusion that there exists a long run association between the variables. Having determined the existence of cointegrating relationship between the variables, the next step in the analysis is the estimation of the ARDL model.

4.2. ARDL model estimation result

In this section, the result of the estimated linear ARDL model is presented and discussed. The result of the baseline model is presented in Table 6.

Table 6 presents the result of the estimated fiscal response baseline ARDL model. From the long run estimates, an increase in the oil price leads to the improvement of government fiscal position via an increase in government balance. The increase in government balance is an illustration of an improvement in government fiscal effort. A rationale for this finding could be that considering Nigeria is an oil-exporting country, an increase in the price of crude oil is associated with higher government revenues via the increase in crude oil sale proceeds and royalties. The increase in revenues over and above the government expenditure outlay leads to higher government surpluses, indicating a better government fiscal position. Further, periods of higher oil price are accompanied by greater fiscal effort because it serves as an opportunity for the government to balance its books and prepare for the rainy days hence the government would want to have higher surpluses that could be used as fiscal buffers during periods of declining oil prices. This finding aligns with those of El Mahmah and Kandil (2019a) and Sohag et al. (2012).

Similarly, an increase in public debt exerts an insignificant effect on the government balance. Although the conventional view is that increase in public debt influences an improvement in government fiscal effort, this appears not to be the case in Nigeria. This could probably be because the public debt position of Nigeria is less than the IMF-World Bank unsustainability threshold level of 55%. Interestingly, an increase in real GDP leads to a loosening of the government's fiscal position via the reduction in government balance. This finding implies that as the economy expands, the government also engages in fiscal expansion. A rationale for this finding could be that the government responds to the economic expansion by more fiscal expansion to further stimulate the economy. Although this signifies higher government confidence in the economy, it also indicates a decrease in the fiscal effort of the government. This finding is contrary to the conventional thinking that economic expansion leads to higher government balances.

In the short run, the government balance responds negatively to a lag increase in oil price indicating a reduction in fiscal effort. This finding is contrary to the findings of the long run model. A rationale for this finding could be considering that oil revenue forms a sizable chunk of government revenues in Nigeria, the government could view the increase in oil price as an opportunity to invest in critical areas and stimulate the economy. Consequently, the government pays more attention to short-term fiscal expansion as opposed to a greater fiscal effort to improve its balance. Just like the long run effect, public debt accumulation influences an insignificant effect on government balance.

Table 5
Johansen cointegration test.

No of Cointegrating Eq.	Trace Statistic	Critical Value	Max-Eigen Statistic	Critical Value
None	51.03515*	29.79707	37.21927*	21.13162
At most 1	13.81587	15.49471	10.04270	14.26460
At most 2	3.773170	3.841466	3.773170	3.841466

*Indicates statistical significance at 5%.
Source: Authors' Computation

Although the contemporaneous effect of real GDP on government balance is insignificant, its lag effect is negative, behaving like its long run effect. The error correction term (ECT) which measures the speed of adjustment signifies that about 73% correction towards long run equilibrium is completed in a year following a shock to the economy.

The bound test is employed to confirm the cointegrating relationship among the variables. The variables are said to be cointegrated if the bound test statistic is greater than the upper bound critical value. From the result presented in the bottom part of Table 6, the statistic is greater than the upper bound critical value at a 5% level of significance. This leads to the conclusion that the variables of the model are cointegrated i.e., there is a long run association among the variables thereby confirming the results of Johansen cointegration test. The post-estimation Breusch-Pagan (BP) serial correlation and Breusch-Pagan-Godfrey (BPG) heteroskedasticity tests indicate that the estimated model does not suffer from the problems of serial correlation and heteroskedasticity because the statistic of both tests is statistically insignificant. The CUSUM and CUSUM of squares plots presented in the appendix indicate that the estimated model is stable.

4.3. The role of fiscal rules

As indicated earlier, one of the contributions of this paper is the examination of the role of the adoption of fiscal rules on the government balance. In other words, this section examines the influence of fiscal rule adoption on the fiscal position of Nigeria. The estimates of the model examining this relationship are presented in Table 7.

In Table 7, the study controls for the adoption of fiscal rules by Nigeria in the model by including it as one of the explanatory variables. From the estimates of the long run model, oil price maintained a positive effect on the fiscal position of the country implying that an increase in oil price leads to a greater fiscal effort. Similar to the result presented in Table 6, an increase in public debt exerts an insignificant effect on government balance, implying that public debt accumulation does not influence greater fiscal effort in the case of Nigeria. Like the result of the baseline model, an increase in real GDP leads to a reduction in the fiscal balance of the government implying that economic expansion influences lesser government fiscal effort. The adoption of fiscal rules by Nigeria leads to a positive impact on the government's primary balance, implying an improvement in the government's fiscal position. Considering the construction of the variable, the coefficient estimate indicates that compared to periods when fiscal rules are not adopted, the periods when fiscal rules are operational are associated with higher government balances. This finding implies that in the long run, the adoption of fiscal rules leads to a better fiscal position of the government. This finding is in tandem with those of Tapsoda (2012) and Heinemann & Yeter (2014) and lends credence to the importance of the adoption of fiscal rules for sound government finance in the long run.

Table 7
The role of fiscal rules.

Variables	Coefficients	Standard Error
Long Run Estimates		
OP	2.254***	0.614
DE	−0.150	0.368
GDP	−4.472***	1.104
FR	4.904**	1.817
C	−1.548**	0.739
Short Run Estimates		
GB(-1)	−0.646***	0.129
OP	1.456***	0.426
DE	−0.311	0.194
DE(-1)	−1.185***	0.235
DE(-2)	−0.522*	0.268
DE(-3)	−1.146***	0.264
GDP	2.506**	1.100
GDP(-1)	−3.208***	0.956
FR	−0.830	0.512
FR(-1)	−2.919***	0.736
FR(-2)	−3.121***	0.603
FR(-3)	−1.347***	0.444
ECT	−0.646***	0.095
Bound Test (F Statistic)	6.10***	
BP Serial Correlation Stat	1.60	
BPG Heteroskedasticity Stat	1.17	
CUSUM Test	Stable	
CUSUM of Squares Test	Stable	
Selected Model (AIC)	ARDL (1, 0, 4, 2, 4)	

***, **, and * signifies significance at 1%, 5%, and 10% respectively.
Source: Authors' Computation

In the short run, an increase in oil price also produces a contemporaneous significant positive effect on government balance indicating an improvement in government fiscal position. This finding is like the result obtained in the long run model. Further, the lag effect of public debt accumulation is a reduction in government balance, signifying a reduction in government fiscal effort. In addition, the effect of economic expansion on the government balance is mixed; while the contemporaneous effect is positive, the lag effect is negative. Interestingly, the adoption of fiscal rules leads to a reduction in government balance in the short run indicating a worsening of government fiscal position. A rationale for this finding could be that the adoption of fiscal rules might impose restrictions that constrain the economy and government revenues thereby leading to a short run negative effect on government balance; however, this is not the case in the long run. It could thus be inferred that although the adoption of fiscal rules leads to a weaker fiscal position in the short run, the gain of fiscal improvement is achieved over the long run.

The error correction term indicates that about 65% correction towards the long run equilibrium is completed in a year following a shock in the economy. From the result presented in the bottom part of Table 7, the bound test statistic is greater than the upper bound critical value at a 5% level of significance. This leads to the conclusion that the variables of the model are cointegrated. The post-estimation BP serial correlation and BPG heteroskedasticity tests indicate that the estimated model does not suffer from the problems of serial correlation and heteroskedasticity because the statistic of both tests is statistically insignificant. The CUSUM and CUSUM of squares plots presented in the appendix indicate that the estimated model is stable.

4.4. Asymmetric response of fiscal position to changes in oil price

As highlighted in the introduction section, one of the key objectives of this paper is to examine if the response of government fiscal effort to oil price changes is asymmetric. Worded differently, the paper investigates if the effect of oil price dynamics on government balance is asymmetric. To achieve this objective, the Non-Linear ARDL model is employed for analysis, the estimation results are presented in Table 8.

Table 8 presents the result of the estimated non-linear ARDL model aimed at examining the asymmetric effect of oil price on the government balance. From the estimated long run model, a positive oil price shock leads to a significant positive effect on government balance, while a negative oil price shock leads to an insignificant positive effect on government balance. This finding implies that an increase in oil price influences an improvement in government fiscal position and by implication an improvement in government fiscal effort. Interestingly, the effect of a decrease in oil price appears to be insignificant. This finding points to the possibility of a symmetric effect of oil price on government fiscal position; to confirm this, the long run estimates will be subjected to a formal test of asymmetry. The significant effect of positive oil shocks on government balance mirrors the finding of the linear ARDL model discussed in Tables 6 and 7 As indicated earlier, the finding of a positive influence of oil price on government balance signifies that periods of higher oil price are accompanied by greater fiscal effort because it serves as an opportunity for the government to balance its books and aim for tighter budgets in preparation for the rainy days

Table 8
Asymmetric effect of oil price (NARDL model).

Variables	Coefficients	Standard Error
Long Run Estimates		
OP^+	3.045***	0.878
OP^-	5.422	3.895
DE	−0.166	0.404
GDP	−2.870***	0.840
C	−3.053**	1.261
Short Run Estimates		
GB (−1)	−0.561***	0.162
OP^+	0.474	0.530
$OP(-1)^+$	−2.571***	0.648
$OP(-2)^+$	−1.805***	0.620
$OP(-3)^+$	−1.705**	0.749
OP^-	3.040*	1.695
DE	−0.093	0.238
GDP	1.625	1.707
GDP(-1)	−4.409***	1.318
GDP(-2)	−2.375	1.462
ECT	−0.560***	0.097
Bound Test (F Statistic)	4.53**	
BP Serial Correlation Stat	1.02	
BPG Heteroskedasticity Stat	1.34	
CUSUM Test	Stable	
CUSUM of Squares Test	Stable	
Selected Model (AIC)	ARDL(1, 4, 0, 0, 3)	

***, **, and * signifies significance at 1%, 5%, and 10% respectively.
Source: Authors' Computation

when fiscal buffers would be required. The finding of an insignificant effect of negative oil price shock on fiscal position is contrary to those of Sohag et al. (2022); the positive effect of oil price increase on government balance is contrary to Bash (2015). Just like the estimates of the linear ARDL model, public debt and real GDP maintained an insignificant and significant negative influence on the fiscal position of Nigeria respectively. The negative effect of economic expansion on government balance implies a decreasing fiscal effort following an increase in national income.

Interestingly, the short run response of government balance to oil price dynamics differs from the long run behaviour. Although the contemporaneous effect of positive oil price shocks on government fiscal position is insignificant, its lag effect is that of decreasing government balance implying a reduction in government fiscal effort. On the contrary, the short run effect of negative oil price shocks is an improvement in government fiscal position via an increase in government balance, implying an improvement of government fiscal effort. A possible explanation for the negative effect of increasing oil price on government balance could be that for oil-producing countries such as Nigeria, a significant increase in oil price is viewed as an opportunity for more government intervention, especially on critical infrastructure and welfare programmes; therefore, the government loosen its fiscal stance and engage in more expenditure at least in the short-term. However, periods of significant fall in the price of crude oil make the government tighten its fiscal effort to avert falling into fiscal distress. Suffice it to state that the magnitude of the effect differs; negative oil price shocks have a greater effect on government fiscal position than positive oil price shocks indicating an asymmetric response of government fiscal effort to oil price dynamics in the short run. This finding contradicts the result of the long run model. A rationale for this finding could be that although the desire to engage in fiscal and economic expansion following positive oil price shocks is pronounced in the short run, the need to maintain fiscal health and a better fiscal position dominates in the long run.

The short run effect of real GDP and public debt is largely similar to the long run behaviour. The error correction term signifies that about 56% adjustment towards long run equilibrium is completed in a year following a shock in the economy. From the bound test F-statistic presented in the bottom part of Table 8, the null hypothesis of no-cointegration is rejected at a 5% level of significance leading to the conclusion of a long run association among the variables. The post-estimation BP serial correlation and BPG heteroskedasticity tests indicate that the estimated model does not suffer from the problems of serial correlation and heteroskedasticity because the statistic of both tests is statistically insignificant. The CUSUM and CUSUM of squares plots presented in the appendix indicate the stability of the estimated model.

The study subjects the coefficients of the estimated NARDL model to a formal test of asymmetry using the Wald coefficient restriction test, this is done to confirm whether the effect of oil price on government balance is asymmetric. From the result presented in Table 9, the null hypothesis of symmetric effect is not rejected in the long run, this finding indicates that oil price has a symmetric effect on government balance in the long run. This finding implies that the response of fiscal position to positive oil price shocks does not differ from that of negative oil price shocks. Consequently, inferences can be drawn from the findings of long run linear ARDL model. On the contrary, the effect of short oil price shocks on government balance is found to be asymmetric implying that the response of government fiscal effort to positive oil price shocks differs from that of negative oil price shocks. Consequently, short run inferences are drawn from the findings of the NARDL model.

5. Conclusion and policy recommendations

This paper examines the response of Nigeria's government balance to oil price dynamics by employing the ARDL and Non-linear ARDL models for analysis. The findings of the study reveal that while the response of government fiscal position to oil price change is symmetric in the long run, the short run response is asymmetric. The findings of the estimated models indicate that an increase in oil price leads to an improvement in government fiscal position, implying an improvement in government fiscal effort. On the contrary, positive oil price shocks lead to a reduction in government balance in the short run, implying a reduction in fiscal effort probably due to the domination of fiscal and economic expansion goals over and above the improvement of fiscal health goals in the short run. Further, negative oil price shocks lead to an improvement in government fiscal position in the short run, implying an improvement in government fiscal effort.

Considering that the Nigerian economy is oil-based, the study recommends the need for factoring in the asymmetric nature of the relationship between government balance and oil price especially in the short run-in fiscal policy decisions. Since oil price dynamics are relatively unpredictable and susceptible to global shocks, the study recommends the need for government to strengthen its fiscal position via running surpluses during periods of oil price increase, this will enable the government to have the buffers required for economic stimulation during periods of downturn. The short run negative effect of positive oil price shocks and positive effect of negative oil price shocks goes against conventional thinking; therefore, policymakers should consider turning the relationship the other way around. Periods of oil price increase should be associated with a greater fiscal effort to improve public finances while allowing space for fiscal loosening in periods of oil price decline. Consequent upon the findings of a long run beneficial effect of fiscal rules adoption on government fiscal position, this study recommends the need for further entrenchment of fiscal rules operation by ensuring that the set thresholds are strictly adhered to, and fiscal

Table 9
Asymmetry test result.

Variable	Test Statistic	Inference
Long Run		
OP	0.62	No asymmetric Effect
Short Run		
OP	9.20***	Asymmetric Effect

*** and ** signifies significance at 1% and 5% respectively.
Source: Authors' Computation

discipline is maintained. Future studies could consider expanding the analysis to a panel of oil-producing countries.

Author statement

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Declaration of competing interest

None.

Data availability

Data will be made available on request.

Appendices.

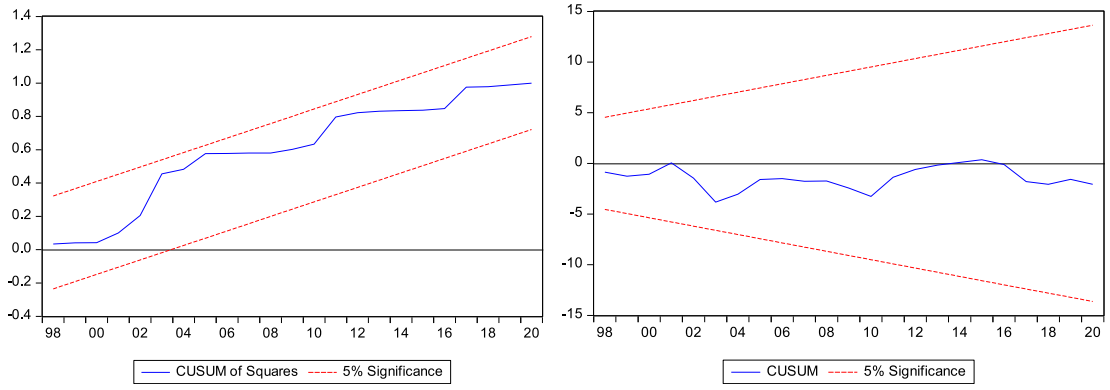

Fig. 4. CUSUM of Squares and CUSUM of ARDL Baseline Model.

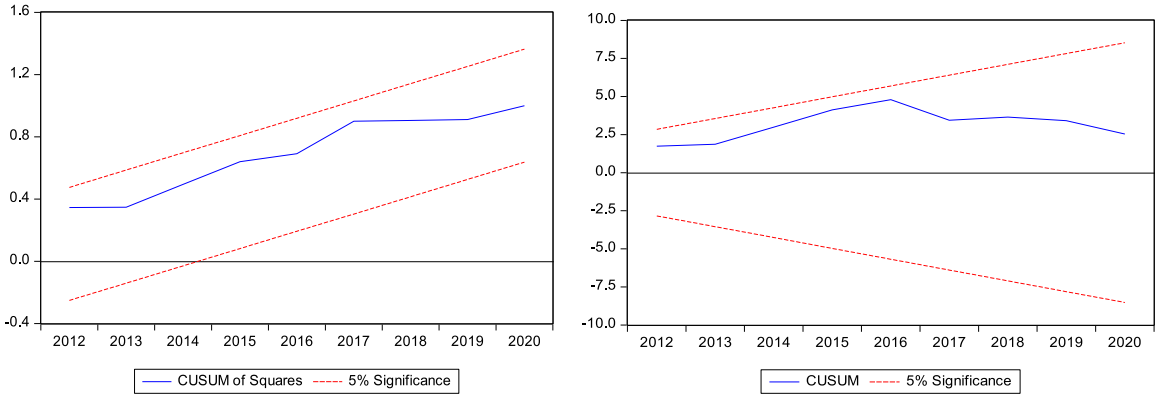

Fig. 5. CUSUM of Squares and CUSUM of Fiscal Rules Model.

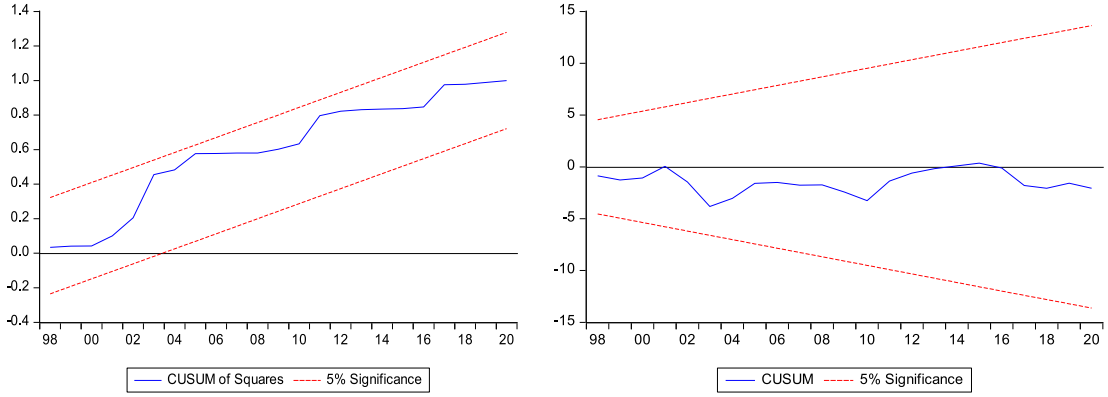

Fig. 6. CUSUM of Squares and CUSUM of NARDL Model.

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